WHAT IS CLAIMED IS:

1. A manufacturing method of a shallow trench isolation (STI) structure, the method comprising:

providing a substrate, wherein a patterned pad oxide layer and a mask layer are formed on the substrate, and at least a trench is formed in the substrate, wherein the trench is formed by exposing a portion of the pad oxide layer and the mask layer;

forming a liner layer on a surface of the trench;

performing a high density plasma chemical vapor deposition (HDP-CVD) process to form an isolation layer on the substrate and over the trench, wherein the trench is completely filled with the isolation layer, wherein the high density plasma chemical vapor deposition (HDP-CVD) process comprises a first stage process and a second stage process, and a bias power of the second stage process is higher than a bias power of the first stage process, and a deposition to etching ratio of the second stage process is lower than a deposition to etching ratio of the first stage process;

removing the isolation layer over the trench;

removing the mask layer; and

removing the pad oxide layer.

2. The manufacturing method of shallow trench isolation (STI) structure of claim 1, wherein the bias power of the first stage process is in a range of about 900W to about 2500W.

3. The manufacturing method of shallow trench isolation (STI) structure of claim 1, wherein the bias power of the second stage process is in a range of about 2500W to about 3300W.

4. The manufacturing method of shallow trench isolation (STI) structure of claim 1, wherein the deposition to etching ratio of the first stage process is in a range of about 10 to about 20.

5. The manufacturing method of shallow trench isolation (STI) structure of claim 1, wherein the deposition to etching ratio of the second stage process is in a range of about 5 to about 10.

6. The manufacturing method of shallow trench isolation (STI) structure of claim 1, wherein the bias power of the second stage process is in a range of about 2500W to about 3300W, and the deposition to etching ratio of the second stage process is in a range of about 5 to about 10.

7. The manufacturing method of shallow trench isolation (STI) structure of claim 1, wherein a material of the isolation layer comprises silicon oxide.

8. The manufacturing method of shallow trench isolation (STI) structure of claim 1, wherein the mask layer comprises a bottom silicon nitride layer on the bottom and a top silicon oxide layer.

9. The manufacturing method of shallow trench isolation (STI) structure of claim 8, wherein the step of removing the isolation layer over the trench further comprises a step of removing the silicon oxide layer.

10. A manufacturing method of shallow trench isolation (STI) structure, the method comprising:

providing a substrate, wherein a patterned pad oxide layer and a mask layer are formed on the substrate, and at least a trench is formed in the substrate, wherein the trench is formed by exposing a portion of the pad oxide layer and the mask layer;

performing an etch-back process to the mask layer to pull back the mask layer;

forming a liner layer on a surface of the trench;

performing a high density plasma chemical vapor deposition (HDP-CVD) process to form an isolation layer on the substrate and over the trench, wherein the trench is completely filled with the isolation layer, wherein the high density plasma chemical vapor deposition (HDP-CVD) process comprise a first stage process and a second stage process, a bias power of the second stage process is higher than a bias power of the first stage process, and a deposition to etching ratio of the second stage process is lower than a deposition to etching ratio of the first stage process;

removing the isolation layer over the trench;

removing the mask layer; and

removing the pad oxide layer.

11. The manufacturing method of shallow trench isolation (STI) structure of claim 10, wherein the bias power of the first stage process is in a range of about 900W to about 2500W.

12. The manufacturing method of shallow trench isolation (STI) structure of claim 10, wherein the bias power of the second stage process is in a range of about 2500W to about 3300W.

13. The manufacturing method of shallow trench isolation (STI) structure of claim 10, wherein the deposition to etching ratio of the first stage process is in a range of about 10 to about 20.

14. The manufacturing method of shallow trench isolation (STI) structure of claim 10, wherein the deposition to etching ratio of the second stage process is in a range of about 5 to about 10.

15. The manufacturing method of shallow trench isolation (STI) structure of claim 10, wherein the bias power of the second stage process is in a range of about 2500W to about 3300W, and the deposition to etching ratio of the second stage process is in a range of about 5 to about 10.

16. The manufacturing method of shallow trench isolation (STI) structure of claim 10, wherein a material of the isolation layer comprises silicon oxide.

17. The manufacturing method of shallow trench isolation (STI) structure of claim 10, wherein the mask layer comprises a bottom silicon nitride layer and a top silicon oxide layer.

18. The manufacturing method of shallow trench isolation (STI) structure of claim 17, wherein the step of removing the isolation layer over the trench further comprises a step of removing the silicon oxide layer.